Atmospheric Sciences (ATSC)

Courses

ATSC 100. Atmospheric Sciences Orientation. 1 Credit.
This course is required for all atmospheric sciences majors. Its purpose is to prepare new students for their university and professional careers by discussing university policies, the advising process, and career options. S/U grading. F.

ATSC 110. Meteorology I. 3 Credits.
Elements of the atmosphere with emphasis on those processes that affect the global atmospheric circulation. Includes laboratory. Prerequisite: MATH 98 or any higher-level math course. Corequisite: ATSC 110L. F,S.

ATSC 110L. Meteorology I Laboratory. 1 Credit.
Laboratory to accompany ATSC 110. Corequisite: ATSC 110. F,S.

ATSC 210. Introduction to Synoptic Meteorology. 4 Credits.
The analysis and portrayal of synoptic weather information. Kinematic flow analyses of barotropic and baroclinic systems. Introduction to many of the products produced by NWS. Includes laboratory. Prerequisite: ATSC 110 and MATH 107. F.

ATSC 220. Extreme Weather and Climate. 3 Credits.
Severe weather is a leading cause of death, injury and property damage. Students will gain an understanding and appreciation of extreme weather events, their impact on society, minimizing risk and the use of technology in detection and forecasting. Students will also learn how climate change impacts the occurrence and severity of extreme weather events. Prerequisite: ATSC 110. F,S.

ATSC 231. Aviation Meteorology. 4 Credits.
A study of weather hazards, meteorological flight planning, aviation weather equipment and human factors in weather flying safety. Prerequisite: ATSC 110. Prerequisite or Corequisite: AVIT 222, AVIT 260 or AVIT 342. F,S.

ATSC 240. Meteorological Instrumentation. 4 Credits.
A study of the theory, design, and accuracy of instrumentation for the measurement of temperature, pressure, humidity, wind, and radiation. In addition, topics such as radar, and the use of aircraft and balloons as instrument platforms are also discussed.Includes laboratory. Prerequisite: ATSC 110 and MATH 103. S.

ATSC 252. Applied Weather Modification. 3 Credits.
Provides a comprehensive introduction to basic concepts of weather modification as currently practiced around the world. It includes a study of cloud physics and seeding theory, a review of past and current programs, and a discussion of related legal, societal, economic and environmental issues. Provides students exposure to the practical aspects of weather modification operations, including program design and evaluation, care and use of seeding materials and equipment, identification of seeding opportunities, and airborne delivery of seeding materials. Prerequisite: ATSC 110. S.

ATSC 270. Computer Concepts in Meteorology. 3 Credits.
The course introduces students to the programming knowledge needed for manipulating observational and model data in the atmospheric sciences. Topics include programming environments, data visualization, coding and debugging strategies, programming modules, and advanced file I/O. The example problems utilize datasets commonly found in the atmospheric sciences. Prerequisite: ATSC 110 and CSCI 160. S.

ATSC 310. Introduction to Weather Forecasting. 3 Credits.
An operations approach to application of practical methodologies of weather analysis using computer textual and graphic analysis systems. Involves routine weather laboratory activities commonly found within the operational sector of meteorology. Prerequisite: ATSC 210. S.

ATSC 315. Broadcast Meteorology. 3 Credits.
An introduction to the field of broadcast meteorology and science communication which provides an overview of television production, the profession of broadcast meteorology, AMS Seal requirements, role of the station scientist, ethics and the production, organization, critique, and presentation of weather and other science information for a public audience. Prerequisite: ATSC 210. F, odd years.

ATSC 320. Storm Experience Field Trip. 3 Credits.
Provides students with the knowledge and thinking skills to forecast, find, safely observe, and document severe thunderstorms. Students will gain experience in short-term storm forecasting and nowcasting techniques, data collection, and direct comparison of observations to forecasts. Prerequisite: ATSC 110 and ATSC 110L, and consent of instructor. SS.

ATSC 345. Remote Sensing of the Atmosphere. 3 Credits.
Fundamental remote sensing concepts and tools including fundamental radiative processes in the atmosphere. Principles and applications of satellite and radar and their uses as meteorological observation and research tools. Additional instruments may be discussed including lidar, wind profilers, radio acoustic profilers, and other profiling systems. Prerequisite: ATSC 210, ATSC 270, and MATH 166. F.

ATSC 350. Atmospheric Thermodynamics. 3 Credits.
An introduction into the theory and application of atmospheric thermodynamics used in synoptic, meso- and microscale meteorology. The course covers the principles of classical thermodynamics and how they are applied to atmospheric processes. Prerequisite: CHEM 121, MATH 166, and PHYS 251. F.

ATSC 353. Physical Meteorology. 3 Credits.
A study of atmospheric processes and properties from a physical standpoint. Includes atmospheric radiation, aerosols, cloud microphysics, and climate dynamics. Prerequisite: ATSC 345. S.

ATSC 355. Surface Transportation Weather I. 3 Credits.
An introduction to the concepts, practices and methodologies used in the surface transportation weather industry. Includes configuration, siting, and data management/quality control of environmental sensor stations, fundamentals of surface transportation weather forecasting, overview of winter road maintenance methods, and applications of geographical information systems technologies in a weather and road maintenance environment. Prerequisite: ATSC 210 and ATSC 240. On demand.

ATSC 360. Dynamic Meteorology. 4 Credits.
Basic equations of motion, atmospheric thermodynamics, balanced motions, and atmospheric disturbances are examined on an introductory level. Prerequisite: ATSC 350. Prerequisite or Corequisite: MATH 266. S.

ATSC 391. Research Methods in Atmospheric Sciences. 1 Credit.
An introduction to the research methods used in atmospheric sciences. This course is the first in a sequence of courses in which students work on a research project under the guidance of a faculty member. It will prepare students for independent research that is required in ATSC 492 Senior Project I and ATSC 493 Senior Project II. S.

ATSC 397. Cooperative Education. 1-2 Credits.
The student will receive credit for on-the-job compensated work experience in various areas of meteorology available within the government, university or private sectors. May be repeated to a total of 12 credits. Prerequisite: Overall GPA of 2.5 or higher and approval of the Coordinator of Atmospheric Sciences cooperative education. Repeatable to 12.00 credits. S/U grading. F,S,SS.

ATSC 405. Numerical Methods in Meteorology. 3 Credits.
This course is designed to introduce students to numerical methods used to solve mathematical problems that are difficult to solve analytically. The course is designed to focus on numerical problems encountered in the field of atmospheric science. Prerequisite: ATSC 360 and MATH 266. F.

ATSC 411. Synoptic Meteorology. 4 Credits.
Development and application of quasi-geostrophic theory, including its application to the development and propagation of surface and upper-level systems, isentropic analysis, IPV theory, fronts, jets, and the relation between the synoptic environment and convection. Includes a laboratory in which concepts are reinforced through map discussion, map analysis, forecasting exercises and forecasting techniques. Prerequisite: ATSC 210 and ATSC 360. F.

ATSC 420. Advanced Weather Forecasting. 4 Credits.
This course is designed to give students hands on experience in the elements of the modernized forecast process required for operational forecasting both individually and collaboratively. This course includes in-depth real-time analysis of weather from the planetary scale to mesoscale, advanced forecasting techniques and strategies at various timescales for diverse clients, and the examination of predictability. A key component of the course will be the development and communication of forecasts through text products, graphics, decision support services, and weather briefings. Prerequisite: ATSC 411. S.

ATSC 441. Radar Meteorology. 4 Credits.
Advanced radar theory, including basic radar principles, digital processing of radar signals, Doppler radar principles, displays, polarization techniques, and characteristic returns. Includes laboratory. Prerequisite: ATSC 345 or consent of instructor. S, even years.

ATSC 450. Introduction to Cloud Physics Meteorology. 4 Credits.
A study of the physics of clouds with emphasis on microphysical processes involved in cloud formation, precipitation production, and dissipation. Includes Laboratory. Prerequisite: ATSC 350 and ATSC 353. S, odd years.

ATSC 456. Introduction to Professional Meteorology. 3 Credits.
A survey of the structure and methods found within the operational and private sector weather community. Provide orientation of professional meteorology methods. While the government sector of operational meteorology will be discussed, the emphasis of the course will focus on aspects of private sector meteorology. Prerequisite or Corequisite: ATSC 350. F, even years.

ATSC 460. Mesoscale Dynamics. 4 Credits.
An introduction to mesoscale dynamics and forecasting. Topics include mesoscale circulations, warm and cold season weather systems, terrain induced weather systems, tropical systems and mesoscale models. Prerequisite: ATSC 360. S.

ATSC 492. Senior Project I. 1 Credit.
A capstone project demonstrating a breadth and depth of knowledge in atmospheric sciences. An original student investigation of a topic to be selected in consultation with a supervising faculty member of the department. Students will demonstrate the ability to communicate their research through both oral and written communication at an advanced level. Prerequisite: ATSC 391, ECON 210 or MATH 321, senior standing in Atmospheric Sciences and consent of advisor. F.

ATSC 493. Senior Project II. 2 Credits.
This is the second semester of a capstone course intended to be a culminating experience. Students are expected to demonstrate a breadth and depth of knowledge in atmospheric sciences. Students will continue to investigate an original topic to be selected in consultation with a supervising faculty member of the department. Students will demonstrate the ability to communicate their research through both oral and written communication at an advanced level. Prerequisite: ATSC 492. S.

ATSC 494. Special Studies in Meteorology. 1-4 Credits.
Designed for those students who wish to pursue advanced topics in meteorology on an individual basis. May be repeated with change of subject matter to a maximum of four credit hours. Prerequisite: Upper division status and consent of the instructor. Repeatable to 4.00 credits. F,S,SS.

ATSC 497. Internship. 1-8 Credits.
Field experiences in various areas of meteorology will be offered as available. May be repeated up to a total of 12 credits. Prerequisite: Permission of instructor and dean. Repeatable to 12.00 credits. S/U grading. F,S,SS.

ATSC 499. Topics in Meteorology. 1-4 Credits.
This course will cover one or more topics in meteorology of special interest to upper division students. Course may be repeated up to a maximum of 6 credits. Prerequisite: Consent of instructor. Repeatable to 6.00 credits. F,S,SS.

ATSC 500. Introduction to Atmospheric Research. 1 Credit.
This course is required for all Atmospheric Science graduate students. A course in the methodology and philosophy of doing research in the atmospheric sciences. Also includes discussion of related topics, including creativity, publication, science and society, and career-related activities. S/U grading.

ATSC 505. Advanced Atmospheric Dynamics. 4 Credits.
A graduate level course in linear perturbation theory, atmospheric oscillations, hydrodynamic instability and the life cycle of extratropical cyclones. F.

ATSC 510. General Circulation. 3 Credits.
Covers the large scale dynamical processes in the atmosphere, including the observed circulation, processes that maintain the circulation, mid-latitude wintertime circulation anomalies, large scale structure of the tropical atmosphere, and the stratosphere and its link to the troposphere. Prerequisite: ATSC 505.

ATSC 515. Advanced Climatology. 3 Credits.
A course on climate from the perspective of utilizing climatic knowledge and information to examine the current state of the climate and how this can be used to explore potential future states. Topics included are an introduction to climatology, basic data and their analysis, climatological analysis, statistical methods, applications and synoptic climatology. Prerequisite: ATSC 540.

ATSC 518. Advanced Synoptic Meteorology. 3 Credits.
Advanced analysis of atmospheric processes important to large-scale flows. Quasigeotropic and semi-geotropic theory, behavior of extratropical systems, fronts and jets, geotropic adjustment, blocking and IPV thinking. Prerequisite: ATSC 505 or equivalent.

ATSC 520. Atmospheric Chemistry. 3 Credits.
Composition of clean and polluted air. Sources and sinks of atmospheric gases and aerosols. The role of atmospheric chemistry in global environmental issues such as acid rain, visibility reduction, climatic change, oxidant enhancement, etc.

ATSC 525. Atmospheric Radiation. 3 Credits.
Radiation transfer processes in the atmosphere. Scattering and absorption of solar and thermal radiation by aerosols and gases. Effects of clouds on the atmospheric radiation budget.

ATSC 528. Atmospheric Data Analysis. 3 Credits.
Introduction to techniques used in the analysis of meteorological data and methods for interpreting their effects: polynomial fitting, method of successive corrections, statistical methods, variational techniques, model initialization, data assimilation, and filter design. Prerequisite: Proficiency in a programming language.

ATSC 530. Numerical Weather Prediction. 3 Credits.
Covers scale analysis in atmospheric prediction; numerical methods; various atmospheric prediction models; the use of filtering, smoothing, interpolation, weighting and adjustment in objective analysis techniques; numerical forecasting; current NWP structures and applications. Prerequisite: ATSC 505.

ATSC 532. Cloud Microphysics Parameterization & Simulation. 3 Credits.
A study of how cloud microphysics processes are parameterized within weather models. Includes a review of the theoretical basis of cloud physics processes, hands-on examination of the parameterization assumptions and their impacts, and analysis and display of model output. Course offered every four years. On demand.

ATSC 535. Measurement Systems. 3 Credits.
An advanced course in meteorological measurement systems, including coverage of performance characteristics of sensors, calibration standards, measuring devices, the effects of making measurements in the atmospheric environment, meteorological measurement systems, and digital data logging and processing.

ATSC 538. Advanced Earth System Sciences. 3 Credits.
Introduction and synthesis of understanding of the components of the Earth system, their interactions, and the consequences of changes in the Earth system for life; identify and quantify Sun-Earth connections associated with solar variability and impact on the Earth System; explore interactions among the major components of the Earth system: continents, oceans, atmosphere, ice, and life; distinguish natural from human-induced causes of change; understand and predict the consequences of change; and consider analysis techniques, with emphasis placed on numerical modeling of phenomena. Prerequisite: Permission of instructor.

ATSC 540. Statistical Methods in Atmospheric Science. 3 Credits.
A course on statistical methods used to describe, analyze, test, and predict atmospheric phenomena. The topics will review basic statistical concepts, statistical data interpretation, theoretical probability distributions, hypothesis testing, uncertainty analysis, regression, time series analysis, and statistical weather prediction and verification. Prerequisite: Must have completed course work in statistics or consent of instructor.

ATSC 545. Hydrometeorology. 3 Credits.
A course designed to study the coupling of atmospheric and hydrologic processes. Topics will cover basic hydrologic concepts, review of atmospheric thermodynamics, atmospheric moisture, precipitation processes, hydrologic cycle, evaporation/evapotranspiration, infiltration, snow and snowmelt processes, runoff mechanisms, land surface processes, and hydrologic modeling.

ATSC 548. Advanced Mesoscale Dynamics. 3 Credits.
An in-depth theoretical and analytical examination of mesoscale convective processes, initiation and characteristics; mesoscale features of tropical systems; orographically-forced and -influenced circulations; local and regional circulations; high-latitude mesoscale systems; an introduction to mesoscale model design, parameterization development, and evaluation. Prerequisite: Upper division or graduate course in dynamics or constent of instructor; ATSC 505 is a recommend corequisite but not required.

ATSC 550. Tropical Meteorology. 3 Credits.
A study of tropical phenomena over a range of scales, including small scale (cumulus clouds, thunderstorms), mesoscale (sea breezes, squall lines), large scale (waves and cyclones), and planetary scale circulations (trade winds, equatorial trough, equatorial waves, monsoons, intraseasonal oscillations, ENSO). Methods for obtaining and using information to study tropical phenomena are examined. Prerequisite: Graduate standing.

ATSC 552. Satellite Meteorology. 3 Credits.
A study of remote sensing technologies for atmospheric applications. Topics include basic radiation and remote sensing methods, image data processing, atmospheric and geometric corrections, radiometric and geometric enhancements, image classification, and selected meteorological applications using satellite remote sensing. S, even years.

ATSC 553. Advanced Satellite Meteorology. 3 Credits.
Addresses advanced topics in satellite meteorology. Includes advanced topics in radiation, scattering by molecules and particles, and retrieval theory and methods for meteorological applications using passive and active satellite remote sensing. Prerequisite: ATSC 552 and ATSC 525. F, even years.

ATSC 555. Advanced Surface Transportation Weather. 3 Credits.
Addresses weather research topics in contemporary surface transportation. Includes maintenance decision support systems construction, applications of artificial intelligence methods, and investigation of land surface effects and applications of advanced mesoscale weather prediction modeling in a surface transportation environment. Prerequisite: ATSC 510 or consent of instructor.

ATSC 560. Boundary Layer Meteorology. 3 Credits.
The interaction of the atmosphere with the earth's surface. The transfer of heat, moisture, and momentum between the atmosphere and the underlying surface. The description of turbulence and the effects of turbulence on the transfer properties of the atmosphere. Prerequisite: ATSC 505.

ATSC 565. Air Quality. 3 Credits.
An in-depth introduction to important areas within the air quality field. Topics covered include the physical and chemical nature of air pollutants; their sources, control, and transport through the atmosphere; their interaction with other atmospheric constituents; their removal through cloud processes, fallout and wet deposition; their effects on visibility, human health, ecosystems, and global climate. Methods related to the measurements of atmospheric pollutants, air quality modeling, and air quality forecasting are discussed. Prerequisite: CHEM 121 or equivalent, and PHYS 251 or equivalent.

ATSC 570. Seminar. 1 Credit.
A discussion course on current research topics and publications related to the field of atmospheric sciences. Students, faculty and guest speakers will present their research and lead the discussion during seminar. Repeatable to 3 credits. Repeatable to 3.00 credits. S/U grading.

ATSC 575. Current/Special Topics in Meteorology. 3 Credits.
A course in specific advanced topics in atmospheric sciences. Largely delivered in a structured, lecture format. Repeatable to 12 credits. Repeatable to 12.00 credits.

ATSC 594. Independent Studies. 1-4 Credits.
Survey investigations, off campus field work, internships, literature searches and/or preliminary research topic of interest to the student. Repeatable to 4 credits. Repeatable to 4.00 credits. F,S,SS.

ATSC 596. Supervised Research. 1-4 Credits.
Research in consultation with departmental faculty. Repeatable to 12 credits. Prerequisite: Master's degree student and consent of the instructor. Repeatable to 12.00 credits. S/U grading.

ATSC 598. Dissertation Research. 1-8 Credits.
Research, in support of the doctoral dissertation, performed in consultation with the student's advisor. Repeatable to 15 credits. Prerequisite: Consent of the instructor. Repeatable to 15.00 credits. S/U grading.

ATSC 996. Continuing Enrollment. 1-12 Credits.
Repeatable. S/U grading.

ATSC 997. Independent Study Report (Non-Thesis Option). 2 Credits.
This course is required for all Atmospheric Science graduate students enrolled in the non-thesis option. Students will be required to independently investigate a topic related to the major field. This study need not be an original contribution to knowledge, but may be a presentation, analysis, and discussion of ideas already in the literature of the field. Prerequisite: Students are required to complete at least one course from each of the core areas: dynamics, physical, earth system, and tools, as well as ATSC 500. S/U grading. F,S,SS.

ATSC 998. Thesis. 1-6 Credits.
Repeatable to 9 credits. Repeatable to 9.00 credits.

ATSC 999. Dissertation. 1-9 Credits.
Repeatable to 18 credits. Repeatable to 18.00 credits.